Nota Lepi. **37**(1) 2014: 43–48 | DOI 10.3897/nl.37.7953

Description of the reduced mouth parts of *Coleophora micronotella* Toll (Lepidoptera, Coleophoridae), with a new synonym

Bernard Landry[1], Giorgio Baldizzone[2*]

1 *Muséum d'histoire naturelle, C.P. 6434, CH-1211 Geneva 6, Switzerland; bernard.landry@ville-ge.ch*

2 *via Manzoni 24, 14100 Asti, Italy; giorgiobaldizzone@tin.it* * *Contribution to Coleophoridae knowledge no. CXXVII*

http://zoobank.org/103A6A77-76A0-4416-AEEF-1DD57AC3A019

Received 13 November 2013; accepted 12 March 2014; published 15 June 2014
Subject Editor: Lauri Kaila

Abstract. The reduced mouth parts of *Coleophora micronotella* Toll (Coleophoridae) are described and illustrated. The proboscis is lacking, but rudimentary maxillary and labial palpi are present. The mouth parts of *C. micronotella* are compared with those of other species of *Coleophora*, including some others with reduced mouth parts, and their possible adaptive value is discussed. *Ramidomia* Falkovitsh, 2005 and *Ramidiomia* Falkovitsh, 2005, a misspelling, are synonymized with *Coleophora* Hübner, 1822.

Résumé. La morphologie des pièces buccales très réduites de *Coleophora micronotella* Toll (Coleophoridae) est décrite et illustrée. Cette espèce présente des palpes maxillaires et labiaux rudimentaires, mais aucun proboscis. Les pièces buccales de *C. micronotella* sont comparées avec celles d'autres espèces de *Coleophora*, incluant quelques-unes ayant des pièces buccales réduites, et la possible valeur adaptative de la réduction des pièces buccales est discutée. *Ramidomia* Falkovitsh, 2005 et *Ramidiomia* Falkovitsh, 2005, à l'orthographe fautive, sont mis en synonymie avec *Coleophora* Hübner, 1822.

Introduction

In Glossatan Lepidoptera, which comprise over 99.9% of the species of the order, the mouth parts typically consist of a labrum bearing a pair of lateral pilifers anteriorly, a haustellum (proboscis) formed by the modified galeae of the maxillae and a pair of maxillary palpi medially, and a pair of labial palpi posteriorly. Mandibles are fully formed only in the non-glossatan Micropterigidae and Heterobathmiidae. In some scattered groups of species of various families and in some larger groups, such as a good proportion of Lasiocampoidea and Bombycoidea, however, a reduction of the mouth parts can be observed. This phenomenon has not been dealt with comprehensively in the literature and we offer some observations in an attempt to explain it in one small species.

As shown in detail by Căpuşe (1971), the members of Coleophoridae, although generally quite small, usually have well-developed mouth parts, especially in the form of prominent, recurved, tri-segmented labial palpi and a functional haustellum. Some species with reduced mouth parts are nevertheless known, such as *C. minipalpella* Baldizzone, 1998, described from Andalusia, Spain and known from only four specimens. Here we describe and illustrate the ves-

tigial mouth parts of *Coleophora micronotella* Toll, 1956, for which there are more specimens available for study.

In the original description, Toll (1956) mentioned the colour of the head and antennae, and indicated that the palps are missing in all of the nine specimens of *C. micronotella* that he had at hand, but said nothing about the lack of proboscis. Falkovitsh (2005) erected the monotypic genus *Ramidomia*, **here synonymized** with *Coleophora* Hübner, 1822 (along with *Ramidiomia* Falkovitsh, 2005, a misspelling) to accommodate *C. micronotella*. Along with Baldizzone et al. (2006) and others, supported by the phylogenetic analysis of Bauer et al. (2012), we find it more coherent to use one large genus *Coleophora* (1340+ described species) than a classification of *Coleophora* subdivided in numerous small genera that have been erected without comprehensive phylogenetic inference, as exemplified by Falkovitsh (2005). The latter author noted that *C. micronotella* has short palpi, with the third segment shorter than the second, but did not mention the lack of proboscis. Subsequent records of the species did not add any more morphological information (Baldizzone 1994; Baldizzone et al. 2006).

Methods

The head of one specimen was mounted on slide in Euparal after maceration in about 15% KOH at 60°C in an oven for an hour, cleaning in 30% ethanol, staining in Orange G and chlorazol black, and dehydrating in baths of 95% ethanol and isopropanol for one hour each.

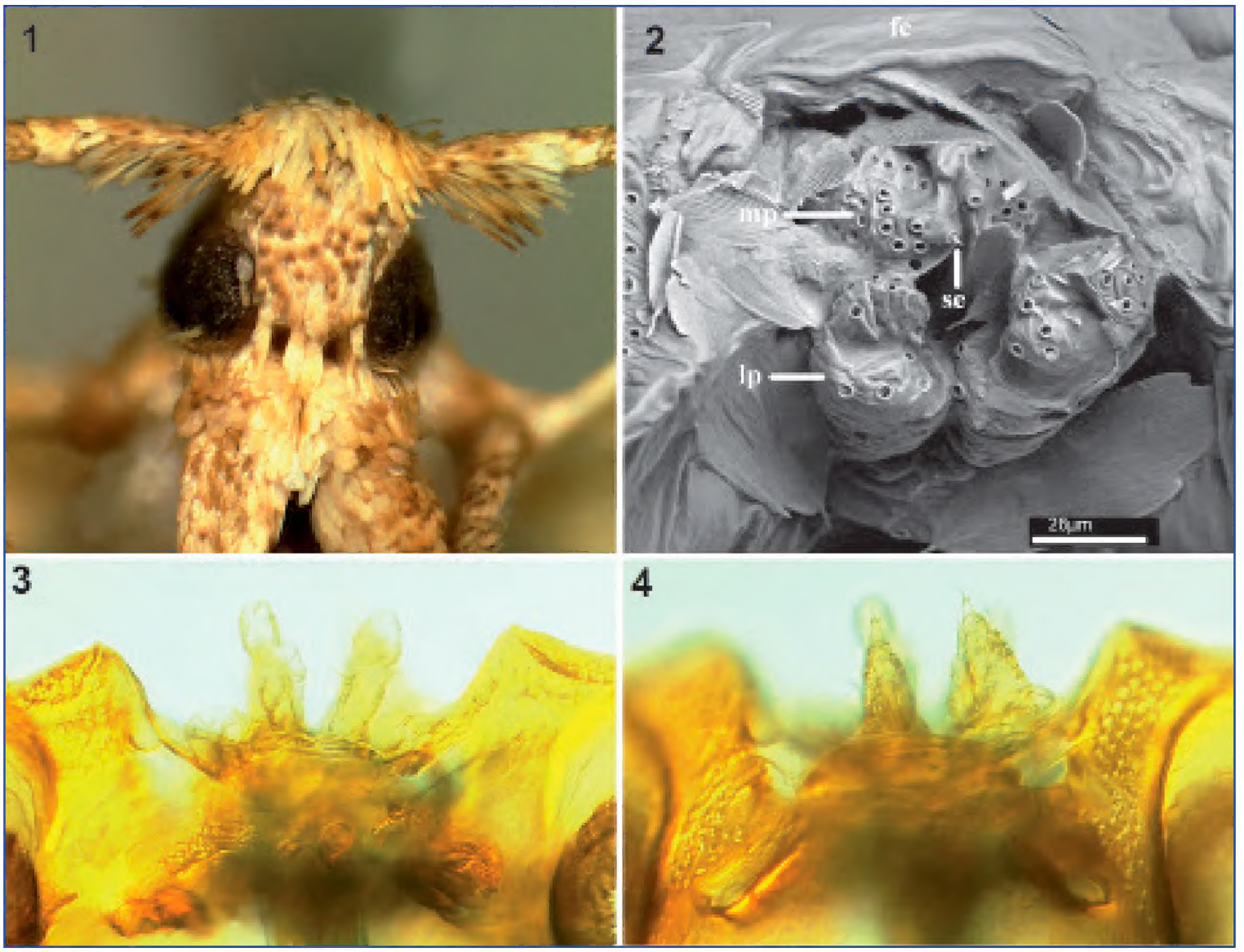
The photographs of the scaled head as well as that of the slide-mounted whole head were taken with a Leica MZ APO dissecting scope and AutoMontage, the close-ups of the mouthparts on slide with a Zeiss microscope and AutoMontage, and the scanning electron micrographs with a Zeiss DSM 940-A scanning electron microscope in the Muséum d'histoire naturelle de Genève (MHNG).

Coleophora micronotella Toll, 1956

Figs 1–4

Material. 2 ♂ (one dissected, slide MHNG ENTO 5970), ♀ [**Italy**] 'SARDEGNA, Orien. | La Caletta | 2.VIII.81-lux | leg.Baldizzone'; 1 ♂ (head prepared for SEM), same data except '29.VII.81'; 2 ♂ (one dissected, slide MHNG ENTO 7501), 'SARDEGNA, Merid. | Porto Botte | 23.VII.81-lux | leg.Baldizzone', deposited in MHNG. 1 ♂ (dissected, slide MHNG ENTO 7503) [**Tunisia**] 'Mauretania | Tunesia-Sud | Oase Tozeur | 28.4.-11.5.1981 | leg. M. u. W. Glaser', deposited in MHNG. Additional material, undissected: 194 specimens from Sardinia (leg. Baldizzone); 30 from **Tunisia** (24 from Tozeur, 1921, leg. Dumont; 7 from Tozeur e Gabes, 1980, leg. Glaser); deposited in collection Baldizzone.

Description of head. Frontal aspect with appressed scales, with short, apparent scaled palpi, without proboscis. Ventral edge of fronto-clypeus slightly sinuate. Labrum not apparent. Maxillary palpi unsegmented, very short, with few scale sockets and setae, with apical sensillum styloconicum. Labial palpi slightly longer than maxillary palpi, reaching apices of subgenal apophyses, with two segments visible, apical segment about half as long as basal segment and lacking vom Rath's organ. With sac-like rounded structure laterally from labial palpi.



Figures 1–4. Head of *Coleophora micronotella* Toll. **1.** Frontal view. **2.** Scanning electron micrograph (fc: fronto-clypeus; lp: labial palp, partly collapsed; mp; maxillary palpus; se: sensillum styloconicum). **3.** Ventral view showing labial palpi. **4.** Dorsal view showing maxillary palpi.

Notes. The halophilous biotope of La Caletta, where three of the specimens of *C. micronotella* studied were collected, is about one kilometer away from the Mediterranean, on the sides of a small canal where tamarix (*Tamarix* sp., Tamaricaceae) grows. The specimens were collected with a black light in a salt marsh where *Salicornia* (Amaranthaceae) and other halophilous herbaceous plants were growing. Hundreds of specimens came to light, but could not come to rest on the sheet because of the presence of thousands of staphylinid beetles and flies. Falkovitsh (2005) recorded that the larva of *C. micronotella* feeds as a borer, without making a case, in 'green branches (assimilating shoots)' of *Halostachys caspica* C.A. Mey. and *Halocnemum strobilaceum* (Pallas) Bieb. (Amaranthaceae).

Described from Tozeur, Tunisia, the species is also found in Italy (mainland, Sardinia, Sicily) and Spain. It has also been reported from Iran (Baldizzone 1994), and Algeria, Kazakhstan, and Tadjikistan (Falkovitsh 2005). However, a specimen from the Iranian series mentioned in Baldizzone (1994) was re-examined and found to represent another, probably undescribed species. Its mouth parts are more developed than in *C. micronotella*, with the labial palpi about as long as 3/4 the widest diameter of the compound eye, but without apparent proboscis. Also, the male valva differs slightly in the distally larger and more evidently separated sacculus from the basally narrower valvula, and the phallus is narrow, needle-like, instead of spatulate.

Other species of *Coleophora* with vestigial mouth parts

Coleophora galligena Falkovitsh, 1970, described from Uzbekistan, has vestigial palpi and no proboscis. *Coleophora daeva* Baldizzone, 1994, *C. minipalpella* Baldizzone, 1998, and *C. zagella* Falkovitsh, 1972, respectively described from Iran, Spain, and Mongolia, have short proboscis and palpi. These four species and *C. micronotella* can be associated with the 8th group of Toll (1953, 1962), based on their simple genitalia, but Toll (1956) only mentioned that *C. micronotella* is close to *C. plurifoliella* Chrétien, and never associated this species with any group subsequently. These species are associated with halophilous habitats and deserts and they were not treated by Bauer et al. (2012).

Discussion

The sac-like rounded structures that protrude laterally from the labial palpi in *C. micronotella* may represent vestigial mandibles. Rudimentary mandibles were found in all species of *Coleophora* studied by Căpuşe (1971), with variation in shape and size. Căpuşe (1971) noted that the mandibles are usually sclerotized, but he found at least one species in which they were membranous (*C. asthenella* Constant). Căpuşe (1971) did not study *C. micronotella*, but for comparison it may be noted that among the 100 species studied he mentioned that the maxillary palpi were missing in one only (*C. asthenella*). Although it is often difficult to count the number of maxillary palp segments precisely because the limits between segments may be not easily discernible, Căpuşe found that the number of segments varied from one to five, the one-segmented species numbering 20, the 2-segmented 31, and the other cases in lower frequencies. Căpuşe (1971) also found that *C. ciconiella* Zeller, a species with two maxillary palpomeres, has the apex of the maxillary palpi adorned with a sensillum styloconicum.

The labial palpi in the Lepidoptera groundplan are tri-segmented (Kristensen 2003). This is the condition found in *Coleophora*, but the overall length of the palpi, length of individual palpomeres, shape of terminal palpomere, and vestiture vary across species. Căpuşe (1971) did not study any species with markedly reduced labial palpi. The lack of vom Rath's organ is unusual in Coleophoridae and presumed here to be linked with the reduction of the labial palpi.

Regarding the proboscis, Căpuşe (1971) recorded no species in which it is lacking, but a few in which it is slightly shorter than the labial palpi, and membranous. No species with reduced mouth parts were found from the Western Hemisphere (J.-F. Landry, pers. comm. to G. Baldizzone), but several undescribed species from the Afrotropical region have reduced proboscis and palps.

Bauer et al. (2012) presented the first phylogeny of Coleophoridae based on a formal analysis of molecular characters; one hundred and two European species were analysed, but neither *C. micronotella*, any of the above-mentioned species with reduced mouth parts, nor any species of Toll's 8th group were included. Nevertheless, two of the species groups recovered, the *albella* and *alticolella* groups, have species feeding on Amaranthaceae, with the larvae of the *albella* group being internal miners in the first larval stages, until they become too large to be fully hidden in the nutritive tissue, after which they build a tubular silk case. This host plant choice and the internal feeding habits may point to an affinity of *C. micronotella* with the *albella* group.

Although the reduction or loss of the proboscis occurs in many glossatan lineages (Kristensen 2003: 54), the adaptations related to the absence of a functional proboscis are unclear, and no discussion of this phenomenon was found in the literature. Căpuşe (1971: 23) believed that in species with reduced galeae, hence without a functional proboscis, the reduction is correlated with the digestive tract, without qualifying this correlation.

Several species of Saturniidae have reduced mouth parts and do not feed as adults (Taylor 1957), presumably to place most of the energy resources acquired during the development of the larva into the production of a larger quantity of eggs and/or into the development of a more efficient mate locating mechanism, hence the highly plumose male antennae. A shift in energy resource allocation may be the reason for reduced mouth parts in *Coleophora micronotella* and others, but it may also be that these species live in habitats where food sources (water, nectar) for adult Lepidoptera with low vagility are too scarce or poisonous, such as with a deleterious salt concentration, for example. The fact that *C. micronotella* and other species with reduced mouth parts live in halophilous or desert biotopes, and that the larva of *C. micronotella* is a borer (a strategy to avoid ingesting too much salt and/or to secure enough water, perhaps) lend support to this hypothesis. We believe that this phenomenon is akin to the loss of functional wings in some Lepidoptera species living on small, wind-swept islands (e.g., Davis & Mendel 2013) or the loss of functional eyes in cave-dwelling animals.

Acknowledgements

Yuriy Budashkin, Ole Karsholt, Niels Peder Kristensen, Jean-François Landry, Rodolphe Rougerie, Jukka Tabell, and Hugo van der Wolf replied to our requests for information. Florence Marteau and André Piuz of MHNG respectively assembled the plate and did the scanning electron micrographs. Jean-François Landry and two anonymous referees provided useful comments on the manuscript. We thank them all very much for their work in our favour.

References

Baldizzone G (1994) Contibuzioni alla conoscenza dei Coleophoridae. LXXV. Coleophoridae dell'Area Irano-Anatolica e regioni limitrofe (Lepidoptera). Associazone Naturalistica Piemontese, Memorie vol 3. Apollo Books, Stenstrup. 424 pp.

Baldizzone G, van der Wolf H, Landry J-F (2006) Coleophoridae, Coleophorinae (Lepidoptera). In: Landry B (Ed) World Catalogue of Insects, Vol. 8. Apollo Books, Stenstrup. 215 pp.

Bauer F, Stübner A, Neinhuis C, Nuss M (2012) Molecular phylogeny, larval case architecture, host–plant associations and classification of European Coleophoridae (Lepidoptera). Zoologica Scripta 41: 248–265. doi: 10.1111/j.1463-6409.2012.00532.x

Căpuşe I (1971) Recherches morphologiques et systématiques sur la famille des Coleophoridae (Lepidoptera). Bucarest. 116 pp.

Davis DR, Mendel H (2013) The genus *Erechthias* Meyrick of Ascension Island, including the discovery of a new brachypterous species (Lepidoptera, Tineidae). ZooKeys 341: 1–20. doi: 10.3897/zookeys.341.6146

Falkovitsh MI (1970) New species of casebearer moths (Lepidoptera, Coleophoridae) associated with trees and shrubs of the family Chenopodiaceae in Soviet Central Asia. Entomologicheskoe Obozrenie 49: 869–885. [In Russian]

Falkovitsh MI (2005) New taxa of casebearers (Lepidoptera, Coleophoridae) from the desert zone of the Palaearctic. Entomologicheskoe Obozrenie 84: 167–176. [In Russian]

Kristensen NP (2003) 4. Skeleton and muscles: adults, pp. 39–131. In: Kristensen NP (Ed) Handbook of Zoology, Vol. IV, Part 36, Lepidoptera, moth and butterflies, Vol. 2, Morphology, physiology, and development. W. de Gruyter, Berlin, New York.

Taylor JS (1957) Notes on the proboscis in the Saturniidae. Entomologist's Record and Journal of Variation 69: 151–153.

Toll S (1953) Rodzina Eupistidae polski. Documenta Physiographica Poloniae 32 [1952]: 293 pp. + 38 pls.

Toll S (1956) Etude de quelques Coleophoridae d'Afrique du Nord et leurs genitalia (Lep). L'Entomologiste 12: 97–109.

Toll S (1962) Materialen zur Kenntnis der palaearktischen Arten der Familie Coleophoridae (Lepidoptera). Acta Zoologica Cracoviensia 7: 577–720 + 133 pls.